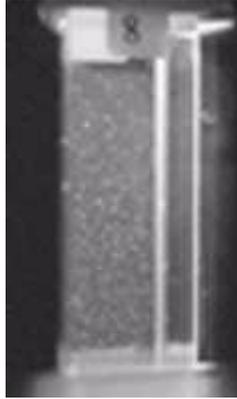


Binary Colloidal Alloy Test Conducted on Mir

Colloids are tiny (submicron) particles suspended in fluid. Paint, ink, and milk are examples of colloids found in everyday life. The Binary Colloidal Alloy Test (BCAT) is part of an extensive series of experiments planned to investigate the fundamental properties of colloids so that scientists can make colloids more useful for technological applications. Some of the colloids studied in BCAT are made of two different sized particles (binary colloidal alloys) that are very tiny, uniform plastic spheres. Under the proper conditions, these colloids can arrange themselves in a pattern to form crystals, which may have many unique properties. For example, someday these colloidal crystals may form the basis of new classes of light switches, displays, and optical devices that can fuel the evolution of the next generation of computer and communication technologies. Windows made of liquid crystals are already in the marketplace. These windows change their appearance from transparent to opaque when a weak electric current is applied. In the future, if the colloidal crystals can be made to control the passage of light through them, such products could be made much more cheaply. These experiments require the microgravity environment of space because good quality crystals are difficult to produce on Earth because of sedimentation and convection in the fluid.

The BCAT experiment hardware included two separate modules for two different experiments. The "Slow Growth" hardware consisted of a 35-mm camera with a 250-exposure photo film cartridge. The camera was aimed toward the sample module, which contained 10 separate colloid samples. A rack of small lights provided backlighting for the photographs.

The BCAT hardware was launched on the shuttle and was operated aboard the Russian space station Mir by American astronauts John Blaha and David Wolf (launched September 1996 and returned January 1997; reflight September 1997 and returned January 1998). To begin the experiment, one of these astronauts would mix the samples to disperse the colloidal particles and break up any crystals that might have already formed. Once the samples were mixed and the experiment was powered on, the hardware operated autonomously, taking photos of the colloidal samples over a 90-day period.



Colloidal crystal photographed by astronaut David Wolf aboard Mir, approximately 90 days after the start of the BCAT experiment.

The "Rapid Growth" hardware was set up in the Microgravity Glovebox. This experiment used a video camera with a low-magnification lens to record five separate samples. The astronauts operated the experiment by first mixing the samples and then recording each sample over a 24-hr period to monitor the colloidal behavior.

Analysis of the BCAT data is in progress and is almost complete. Results indicate that it is indeed possible to form new materials in microgravity. Some samples in the BCAT Slow Growth experiment were observed to form ordered crystalline structures in space even though they do not do so in Earth's gravity. During the BCAT Rapid Growth experiment, the colloidal structure persisted through the whole flight. The structure did not collapse as it does on Earth.



BCAT Rapid Growth hardware.



BCAT Slow Growth hardware.

BCAT results are providing important new information about the behavior of several different colloidal systems. The investigation proved that gravity plays a central role in the formation and stability of these types of colloidal crystal structures. The investigation also helped identify the optimum conditions for the formation of colloidal crystals, which will be used for optimizing future microgravity experiments in the study of colloidal physics. Dr. David Weitz of the University of Pennsylvania and Dr. Peter Pusey of the University of Edinburgh, United Kingdom, conceived the experiments. The hardware and software were designed, built, and tested by a contractor team from NYMA, Inc., and Aerospace Design & Fabrication (ADF) at the NASA Lewis Research Center in Cleveland, Ohio.

Find out more about BCAT: <http://exploration.grc.nasa.gov/expr4/bcat.htm>.

Find information about related research:

Colloidal Gelation (CGEL): <http://exploration.grc.nasa.gov/expr3/cgelpage.html>

Physics of Hard Spheres Experiment (PhaSE) : <http://exploration.grc.nasa.gov/phase/>

Physics of Colloids in Space (PCS) : <http://exploration.grc.nasa.gov/6712/pcs.htm>

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